Jadeitite: A record of metasomatism at various depths in Guatemalan subduction zones

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Jadeitites crystallize from hydrous subduction-related fluids in serpentinizing peridotite. The strike-slip Motagua Fault in Guatemala has brought jadeitites to the surface several times. Along the north side of that fault we studied 8 jadeitite locales along 65 km of E-W strike, and on the south side 3 locales along 15 km. We identified at least 4 distinct PTx settings for jadeitite.

Jadeitites north of the fault are all quite similar, light colored and altered by late-stage fluids. The presence or absence of potassic phases may be a further subdivision. A modest jadeite (Jd) – omphacite (Omph) gap and zoisite suggest 300-400°C. Absence of quartz (Qtz) and common albite (Ab), mica, and late analcime (Anl) suggests P = 6-10 kb. Albitites are common, implying further fluid crystallization at lower P and higher a_{SiO_2}. The associated rocks are garnet-zoisite-amphibole (with some retrograde eclogite) and omphacite-taramite metabasites.The southern jadeitites are subdivided as follows:

1- San Jose jadeitites are green to blue-green with late omphacite veins and little alteration. A larger Jd – Omph gap and lawsonite suggest 300-400°C, and higher P as indicated by Qtz at P = 12-20 kb. Lawsonite eclogites (P = 20-25 kbar, T = 350-450°C) occur with these jadeitites.

2- La Ceiba jadeitites are moderate to intense dark green, occasionally lavender, with veins of quartz, diopside, cymrite, and vesuvianite. A large Jd – Omph gap suggests 300-400°C and, as indicated by Qtz $\pm$ Ab, P = 10-14 kb. These coexist with omphacite-glaucophane blueschists.

3- La Ensenada jadeitites are whitish with green, blue, orange, and mauve. A large Jd – Omph gap and pumpellyite suggests <200-~300°C at lower P=6-9 kb as indicated by primary Ab and secondary Anl. These are very low in iron and coexist with pure clinochlore and magnetite, which all suggest ferrous iron removal by a fluid. These are found with lawsonite-glaucophane blueschists and chloritite.

These four types of Guatemalan jadeitite record differences in fluid composition, crystallization T and P, and a variety of sodic metasomatic processes.

The origin of replacement dolomite, Dolomites, northern Italy: Part 1

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Massive dolomite typically forms at depth and elevated T through replacement of limestone by its reaction with flowing dolomitizing fluid. Details of the physical mechanisms of flow, and the chemical reactions remain unresolved. Our integrated mapping, stable isotope, and major- and trace-element study of the Triassic Latemar buildup addresses these issues. The Latemar is an ideal study area because dolomitization was arrested with both dolomite and unreacted limestone well-exposed in 3D. Boundaries between the dolomitized and undolomitized regions are sharp (usually <10 cm wide) and are easily mapped because of a color difference between limestone and dolomite. The distribution of dolomite was mapped on buildup- to m-scales to define the flow channels of dolomitizing fluid. Dolomite at lower elevations occurs as brecciated columns or vertical sheets; at higher elevations dolomite occurs mainly as horizontal, bedding-parallel sheets and tubes, and less commonly as vertical breccia pipes and sheets parallel to fractures and margins of dikes. The distribution of dolomite images an orthogonal lattice of interconnected vertical and bedding-parallel flow channels. The $^{87}Sr/^{86}Sr$ of Latemar dolomite is 0.7076-0.7079 and fluid inclusions in dolomite have salinities 3.6-5.1 wt % NaCl equivalent [1], implying seawater or seawater-derived fluid was the agent of dolomitization. Dolomite has $\delta^{18}O$ = 21.5-27.4‰ (VSMOW), corresponding to T = 52-88°C (assuming equilibration with fluid of $\delta^{18}O$ = 0). Calcite in limestone has $\delta^{18}O$ = 23.3-28.4‰, corresponding to T = 25-52°C. Dolomite has $\delta^{13}C$ = +1.9 to +4.4‰ (VPDB), and calcite has $\delta^{13}C$ = +1.1 to +4.0‰. Calcite in limestones has average X_{Ca} = 0.987, X_{Mg} = 0.013, and X_{Fe} < 0.001 (microprobe analysis). Typical dolomite has X_{Ca} = 0.537, X_{Mg} = 0.457, and X_{Fe} = 0.006, although dolomite that occurs in high-T regions is more enriched in Fe: X_{Ca} = 0.520, X_{Mg} = 0.464, and X_{Fe} = 0.016. The presence of Fe in dolomite, as well as Mn- and Zn-enrichment from preliminary LA-ICPMS data, indicates that Triassic seawater alone was not the dolomitizing fluid. We suggest a mixture of Triassic seawater and hydrothermal fluid produced by the reaction of seawater with hot, mafic rocks of the adjacent Predazzo volcanic-intrusive complex that was active during dolomitization.

Reference

[1] Wilson, E. N. et al., (1990) *Am. J. Sci.*, **290**, 741-796.